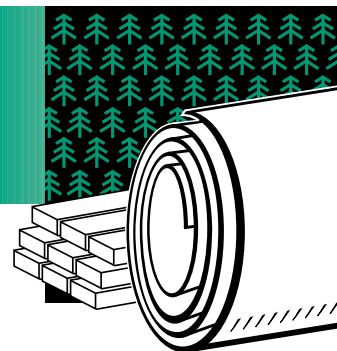


# FOREST PRODUCTS

## Project Fact Sheet

### INTEGRATED ACOUSTIC KILN MONITOR TO GUIDE ACCELERATED DRYING OF WOOD



#### BENEFITS

- Could save 0.64 billion Btu per installation annually
- Could save the forest products industry 2.7 trillion Btu annually by 2010
- Reduces wood residue by 78 tons, and ash by 8 tons
- Offers online detection of the incipient changes in lumber in the kiln that indicate the onset of drying damage
- Provides on-line indication of the wood's moisture content above the fiber saturation point
- Allows clear, real-time measurement of the lumber for the kiln operator
- Reduces the drying cycle, which in turn translates into added kiln throughput capacity

#### APPLICATIONS

The integrated acoustic kiln monitor represents a new era of kiln-control systems and is applicable to all sawmills that process over 2 million board feet of lumber per year. Market development will focus first on domestic hardwood mills because hardwood requires longer drying times and is more susceptible to damage during accelerated drying. Additional sales opportunities exist in teaming with other kiln and monitor manufacturers.

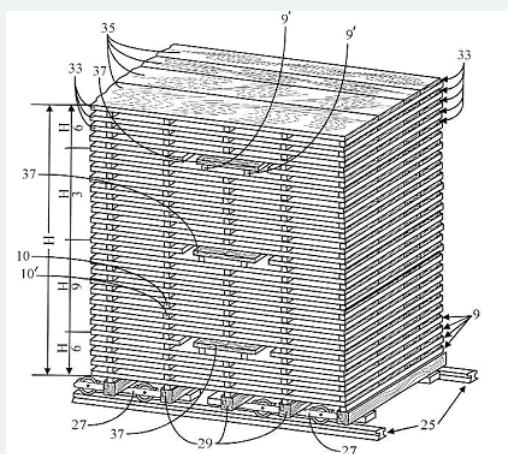
### NEW TECHNOLOGY PROVIDES KILN OPERATORS WITH AN UNPRECEDENTED VIEW OF THE CONDITION OF LUMBER DURING ACCELERATED DRYING WITHOUT WOOD DAMAGE

The ever-increasing demand for finished lumber is pushing the forest products industry to increase kiln throughput by shortening the drying time. However, accelerated drying can cause large moisture gradients within the lumber, which shrinks the lumber nonuniformly and results in cracking, splitting, and quality loss.

Generally, an operator monitors the kiln by entering the kiln to weigh sample boards and calculate moisture content. In recent years, capacitance and conductance monitoring systems were introduced to automatically change kiln conditions. The conductance technique depends on point measurements that do not effectively indicate the condition of the whole board. The capacitance technique provides an average moisture content that does not take into account the moisture differentials that control stress development in the board. Both the conductance and capacitance techniques lack precision and repeatability.

The integrated acoustic kiln monitor uses an acoustic technology to accurately measure average moisture content at all levels, including those above the fiber saturation point. At the same time, acoustic emissions are monitored from the lumber as evidence of stress and impending damage. By using both measurement techniques, kiln operators can accelerate drying by 5% to 20% without damaging the wood.

#### STACK OF LUMBER IN A KILN FOR ACOUSTIC KILN MONITORING



The new integrated acoustic kiln monitor, being developed by Perceptron, Inc., allows sawmill operators to increase the throughput of kiln operations and save energy by accurately measuring the moisture content of wood during the drying process.



## Project Description

**Goal:** Unite two proven acoustically based technologies into several preproduction prototypes and demonstrate their capacity in a commercial environment.

The integrated acoustic kiln monitor brings two separate acoustic techniques together into one system. The Ultrasonic Moisture Meter measures the correlation between the wood's moisture content and the speed with which sound waves travel through the wood. The kiln monitor detects and counts acoustical emissions associated with wood under stress. The integrated acoustic kiln monitor combines these two techniques into a proprietary integrated sticker system. This sticker system allows sensors to be strategically placed in the kiln stack to improve the acoustic coupling needed to detect the tiny acoustic emissions from drying wood and then transmits the information automatically and continually to a CPU. The system can operate as a stand-alone or as an integrated part of the operator's existing kiln-monitoring program.

Perceptron, Inc., is developing this new technology with the help of a grant funded by the Inventions and Innovation Program in the U.S. Department of Energy's Office of Industrial Technologies.

## Progress and Milestones

- Construct two engineering prototypes and modify them based on initial testing.
- Finalize software interfaces for acoustical emissions and transmission of ultrasound.
- Complete and test the two engineering prototypes in commercial kilns.
- Redesign/rebuild preproduction prototypes based on full-scale kiln test results and then field test the preproduction prototypes.

## Economics and Commercial Potential

The market for the integrated acoustic kiln monitor comprises over 4000 hardwood and 3000 softwood mills, each processing over 2 million board feet of lumber per year.

Perceptron's current customer base will be the initial targeted clientele.

Substantial energy savings are expected, given that kiln drying consumes 60% to 70% of the total energy required in manufacturing wood products. Although energy savings will vary, test results indicate that the drying time for red and white oak can be reduced by at least 10%, reducing energy consumption by 5%. This technology could save 142 billion Btu per average installed unit each year. First sales for the technology are expected by 2003. Based on 60% market penetration by 2010, annual savings could be 2.7 trillion Btu with 4200 units operating. Market penetration of 70% by 2020 could save 3.1 trillion Btu from operations at 4900 units.

Because new kilns are expensive to construct and operate, increasing the throughput for existing kilns makes economic sense. A typical 25,000-board-feet capacity kiln processing oak at 500 hours per cycle dries roughly 425,000 board feet of green lumber per year. Reducing drying time by 20% could increase the capacity to 547,000 board feet per year for a net increase of 122,000 board feet.

## INDUSTRY OF THE FUTURE—FOREST PRODUCTS AND AGENDA 2020

*In November 1994, DOE's Secretary of Energy and the Chairman of the American Forest and Paper Association signed a compact, establishing a research partnership involving the forest products industry and DOE. A key feature of this partnership was a strategic technology plan, **Agenda 2020: A Technology Vision and Research Agenda for America's Forest, Wood, and Paper Industry.** Agenda 2020 includes goals for the research partnership and a plan to address the industry's needs in six critical areas:*

- Energy performance
- Environmental performance
- Capital effectiveness
- Recycling
- Sensors and controls
- Sustainable forestry

**OIT Forest Products Team Leader: Valri Robinson (202) 586-0937.**



The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and conduct early development. Ideas that have significant energy savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

### FOR PROJECT INFORMATION, CONTACT:

Mark E. Schafer, Ph.D.  
Perceptron, Inc.  
Ultrasound Technology Group  
P.O. Box 825  
Spring House, PA 19477-0825  
Phone: (215) 641-4909  
Fax: (215) 641-9254  
mschafer@perceptron.com  
Home Page:  
www.perceptron.com

### FOR PROGRAM INFORMATION, CONTACT:

Lisa Barnett  
Program Manager  
Inventions & Innovation Program  
U.S. Department of Energy  
1000 Independence Ave., SW  
Washington, DC 20585-0121  
Phone: (202) 586-2212  
Fax: (202) 586-7114  
lisa.barnett@ee.doe.gov

### FOR PROJECT UPDATES:

Visit our home page at  
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Office of Industrial Technologies  
Energy Efficiency  
and Renewable Energy  
U.S. Department of Energy  
Washington, DC 20585-0121



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